United States Air Force

Five-Year Review Report

Pease Air Force Base

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September 1999

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United States Air Force

Five-Year Review Report

Pease Air Force Base

Final Draft

September 1999

PEASE AIR FORCE BASE

FIVE-YEAR REVIEW REPORT

FINAL DRAFT

SEPTEMBER 1999

Prepared for:

Air Force Base Conversion Agency (AFBCA)
The Pentagon, Washington DC 20330

Air Force Center for Environmental Excellence (AFCEE)
Base Closure Division (AFCEE/ERB)
Brooks Air Force Base, TX 78235-5328

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35014

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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BOSTON, MASSACHUSETTS 02114-2023

September 30, 1999

Mr. Arthur Ditto
AFBCA Pease
302 Newmarket Street
Building 151
Pease ANGB, NH 03803-0157

Re: Five-Year Review Report, Pease Air Force Base NPL Site

Dear Mr. Ditto:

This office is in receipt of the Air Force's *Five-Year Review Report, Pease Air Force Base* dated September 1999. Upon review of this report, EPA concurs with the findings that all remedies which have been implemented are protective of human health and the environment, and those operable units which still require final remedial actions have one or more actions implemented (land use restrictions, contaminated soil removal, full scale technology demonstration pilot implementation, environmental monitoring, etc.) to ensure the protection of human health and the environment.

Based on EPA's *Supplemental Five-Year Review Guidance, Office of Solid Waste and Emergency Response (OSWER) Directive 9355-02A* (August 1994), "when a Region conducts a five-year review after the time it is due, the next five-year review is due within five years of the time when it was originally required". This five-year review was triggered by the remedial action start date for Landfill 5 which was documented by EPA to be September 30, 1994 and was therefore due September 30, 1999. In summary, the next statutory required five-year review for Pease Air force Base will need to be finalized on September 30, 2004.

Sincerely,

Patricia L. Meaney

Patricia L. Meaney, Director
Office of Site Remediation and Restoration

cc: Richard Pease, NHDES
Scott Hilton, NHDES
Mary Sanderson, EPA-New England
Mike Daly, EPA-New England

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FIGURES

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TABLES

ACRONYMS AND INITIALISMS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AGQS	ambient groundwater quality standard
AHC	aromatic hydrocarbons
ARAR	applicable or relevant and appropriate requirement
AS	air sparging
AWQC	Ambient Water Quality Criteria
BA	Burn Area
BFSA	Bulk Fuel Storage Area
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRD	construction rubble dump
CREW	concrete recovery extraction well
DCE	dichloroethene
DNAPL	dense nonaqueous-phase liquid
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
FDTA	Fire Department Training Area
FMS	Field Maintenance Squadron Equipment Cleaning Area
FS	feasibility study
GAC	granular-activated carbon
GMZ	groundwater management zone
GWTP	groundwater treatment plant
HHC	halogenated hydrocarbon
HWSA	hazardous waste storage area
IRM	interim remedial measure
IRP	Installation Restoration Program
JETC	Jet Engine Test Cell
LF	Landfill
LFTS	Leaded Fuel Tank Sludge Area
LNAPL	light nonaqueous-phase liquid
MCL	maximum contaminant level
MRDDA	McIntyre Road Drum Disposal Area
MTBE	methyl tert-butyl ether
NHDES	New Hampshire Department of Environmental Services
O&M	operation and maintenance
OJETS	Old Jet Engine Test Stand
PAH	polynuclear aromatic hydrocarbon
PCDA	Paint Can Disposal Area
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PCMMP	Post Closure Maintenance and Monitoring Plan
PDA	Pease Development Authority
POTW	publicly owned treatment works
PRW	permeable reactive wall
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act

ACRONYMS AND INITIALISMS (continued)

RI	remedial investigation
RO	remedial objective
ROD	record of decision
SVE	soil vapor extraction
SVOC	semivolatile organic compound
TBC	to be considered
TCE	trichloroethene
TI	technical impracticability
TPH	total petroleum hydrocarbon
UST	underground storage tank
VOC	volatile organic compound

UNITS OF MEASURE

µg	microgram
bgs	below ground surface
ft	foot
gal	gallon
gpm	gallon per minute
hp	horse power
in.	inch
in. Hg	inches of mercury
kg	kilogram
lb	pounds
mg	milligram
MSL	mean sea level
ppb	parts per billion
psig	pounds per square inch gauge
scfm	standard cubic foot per minute
yd	yard
yd^3	cubic yard

EXECUTIVE SUMMARY

Introduction

At Pease Air Force Base (AFB), certain site-specific or zone-wide (operable unit) remedial actions are being performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). For those CERCLA-designated sites where active remedial systems and actions are in progress, it was agreed in the pertinent Records of Decision (RODs) that a Five-Year review would be conducted by the Air Force, with assistance from the U.S. Environmental Protection Agency (EPA) and the New Hampshire Department of Environmental Service (NHDES). This Five-Year review for 1999 constitutes the first required review/reporting cycle for Pease AFB.

Organization

This five-year report covers multiple remedies and operable units at the Pease AFB. A summary of the sites and zones covered in this report is as follows:

- Sites with Remedial Action Implemented – Zone 1, Landfill 5 (LF-5); Zone 2, Sites 10, 37, and 22; Zone 3, Sites 32/36 and 34/35/39; Zone 4, Landfill 6 (LF-6); Zone 5, Site 8; Zone 7, Site 45
- Sites or site areas with Long-Term Monitoring Only, Remedial Action Required and Completed – Zone 1, Pauls Brook; Zone 3, McIntyre Brook; Zone 1, Railway Ditch
- Sites or site areas with Long-Term Monitoring Only, No Remedial Action Requirement other than Long-Term Monitoring – Zone 2, Upper/Lower Peverly Ponds and Bass Pond; Zone 4, Lower Grafton Ditch; Zone 5, Knights Brook and Pickering Brook
- Sites without Remedial Action Implemented - Sites 49 and 73

Conclusions and Recommendations

The site-specific or zone RODs identified remedial action objectives (RAOs) which defined the scope and purpose of the cleanup action required to address the potential threats to human health and the environment. After the remedial action has been implemented, the RAOs continue to serve as a metric against which the monitoring and performance data are measured.

Overall, the remedial actions and remedial systems at Pease AFB are successfully meeting the site-specific or zone RAOs and are achieving their principal performance goals of removing contamination from the source areas.

Where cleanup goals are presented in the RODs, the ARARS identified remain current, with the exception of New Hampshire's Groundwater Protection Rules, Env-Ws 410, which expired in February 1999. These expired rules were replaced by "Groundwater Management and Groundwater Release Detection Permits, Env-Wm 1403" which was promulgated on February 24, 1999. As a result of this action by the State of New Hampshire, some of the regulatory standards for compounds with cleanup goals established in various RODs for the Pease AFB CERCLA site have changed. The changes in regulatory standards made by Env-Wm 1403 do not negatively impact the selection and current protectiveness of the various remedial actions implemented at Pease AFB. Additionally, no new state or federal laws have been enacted which may call into question the selection and protectiveness of the implemented remedies.

The Air Force affirms (certifies) that the remedies for the sites addressed in this report remain protective of human health and the environment. The remedies also comply with ARARs and are reasonably cost-effective. Those remedies that rely on some form of treatment are reducing the toxicity, mobility, and/or volume of

hazardous substances at those sites. It is expected that the remedial activities at Pease AFB will permanently reduce the risks to human health and environment by eliminating, reducing, or controlling exposures to human and environmental receptors through engineering and institutional controls. Furthermore, there are no known areas of noncompliance.

General recommendations for Pease AFB include:

- The remedial actions should continue to be implemented in accordance with the EPA and NHDES-approved plans governing system operation, maintenance, and long-term monitoring.
- Annual evaluations of system operation and environmental monitoring should continue and be used as a means of identifying opportunities to both optimize the operation of the system (either to accelerate contaminant removal or improve cost-effectiveness) and refine long-term monitoring activities.
- Future evaluations (annual reports) of the remedial systems and long-term monitoring should attempt to identify the level of progress toward meeting site- or zone-specific cleanup goals developed during the remedy decision-making process.

1.0 FIVE-YEAR DOCUMENT OVERVIEW

At Pease Air Force Base (AFB), certain site-specific and zone wide remedial actions are being performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). For CERCLA-designated sites or zones where active remedial systems and actions are in progress, it was agreed in the pertinent Records of Decision (RODs) that a Five-Year Review would be conducted by the Air Force, with assistance from the U.S. Environmental Protection Agency (EPA) and the New Hampshire Department of Environmental Service (NHDES). This Five-Year Review report for 1999 constitutes the first required review/reporting cycle for Pease AFB.

Figure 1-1 shows the location and vicinity of Pease AFB, Figure 1-2 shows the base plan view, and Figure 1-3 shows the land use in the vicinity of Pease AFB. There have been no changes in land use or in land use assumptions originally made when the remedies for Pease AFB sites were selected, nor have there been any changes in land use or land use assumptions at sites where no further action decisions were made. The existing land use controls and land use restrictions, as specified and managed by the Air Force under the Pease Master Lease Agreement (April 1992) and Supplement Lease Agreement No. 3 (June 1997), have provided the necessary controls to ensure that remedial activities are not compromised and remain protective of human health and the environment.

1.1 DOCUMENT ORGANIZATION/STRUCTURE AND REQUIRED SITES

This five-year report will cover site-specific and zone-wide (operable units) remedies at Pease AFB. Each site or zone reviewed will be covered as appropriate to its progress in remediation. The report is structured such that each section groups sites of zones of similar status together as follows:

Sites with Remedial Action Implemented (Section 2.0)
- Zone 1, Landfill 5 (LF-5)
- Zone 2, Sites 10, 37, 22
- Zone 3, Sites 32/36
- Zone 3, Sites 34/35/39
- Zone 4, Landfill 6 (LF-6)
- Zone 5, Site 8
- Zone 7, Site 45

Sites with Long-Term Monitoring Only, Remedial Action Required and Completed (Section 3.1)
- Zone 1, Pauls Brook (surface water and sediment)
- Zone 3, McIntyre Brook (surface water and sediment)
- Zone 1, Railway Ditch (surface water and sediment)

Sites with Long-Term Monitoring Only, No Remedial Action Requirement other than Long-Term Monitoring (Section 3.2)
- Zone 2, Upper/Lower Peverly Ponds, Bass Pond (surface water and sediment)
- Zone 4, Lower Grafton Ditch (surface water and sediment)
- Zone 5, Knights Brook, Pickering Brook (surface water and sediment)

Sites without Remedial Action Implemented (Section 4.0)
- Site 49
- Site 73

1.2 NEXT REVIEW

Given that this first five-year review is being completed in 1999, the next five-year review will be conducted in 2004. The review will cover specific sites and zones as appropriate at the time of the review cycle.

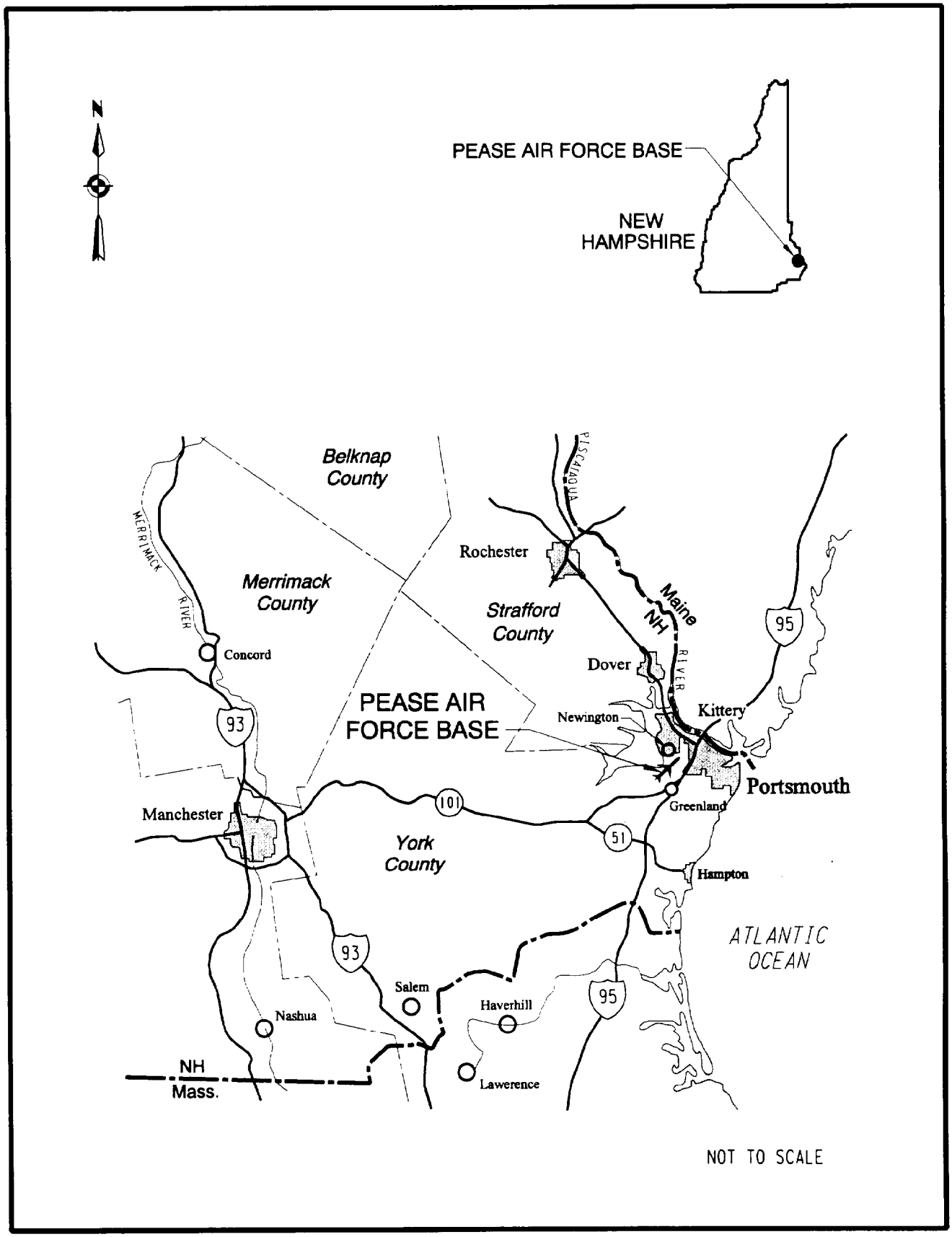

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Figure 1-1
Location and Vicinity Map
Pease AFB, NH

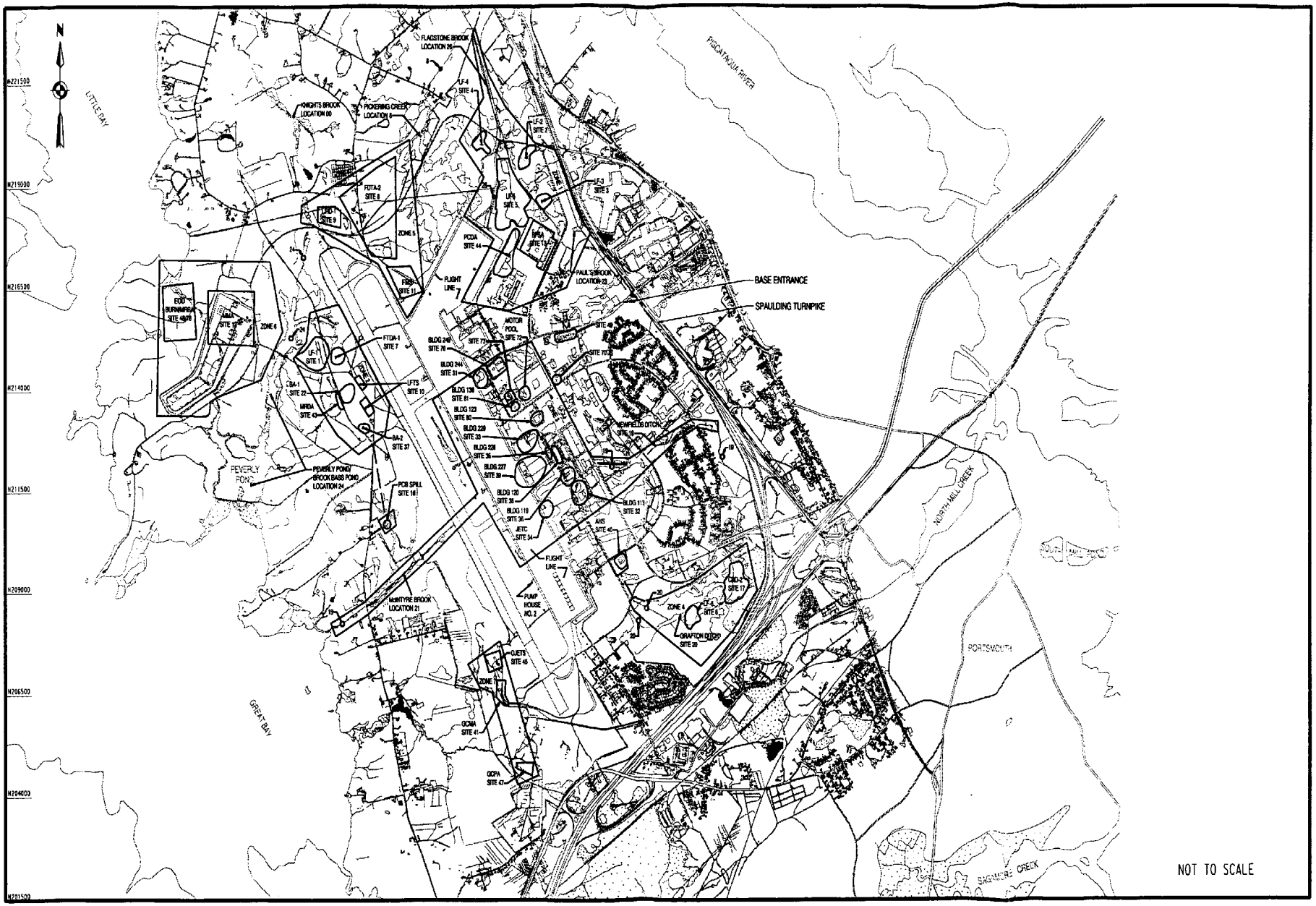

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Figure 1-2
Basewide Zone and Site Boundaries
Pease AFB, NH

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: DOC#. 35074

Pease Air Force Base, Five Year Review
Figure 1-3: Land Use Map - January 1997

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW
BY APPOINTMENT
AT THE EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

2.0 SITES WITH REMEDIAL ACTION IMPLEMENTED

2.1 ZONE 1, LANDFILL 5

2.1.1 Introduction

2.1.1.1 Site Location and Description

Landfill 5 (LF-5), originally identified as Installation Restoration Program (IRP) Site 5, is located within IRP Zone 1, in the northeastern portion of Pease AFB (Figure 2.1-1). The original landfill occupied approximately 23 acres; consolidation of the wastes during remedial action resulted in a capped area of approximately 18.5 acres. The site is bordered by Arboretum Drive to the north, the Railway Ditch paralleling an abandoned railway bed to the east, Flagstone Brook to the west, the Paint Can Disposal Area (PCDA) to the south, and the Bulk Fuel Storage Area (BFSA) to the southeast.

2.1.1.2 Site History and Contaminant Sources

LF-5 reportedly was used between 1964 and 1975 as the primary base landfill, although some disposal occurred as late as 1979. The bulk of the material disposed of in the landfill consisted of typical municipal-type solid wastes generated from the on-base housing, barracks, offices, dining facilities, etc. Industrial wastes were also disposed of in the landfill, including an unspecified quantity of waste oils, solvents, paints, paint strippers and thinners, pesticide containers, empty cans and drums, and sludge from the industrial waste treatment and base wastewater treatment facilities. Landfill operations included trench and fill methods involving excavation of overburden soils such that in many areas wastes were buried in direct contact with the underlying weathered bedrock.

2.1.1.3 Summary of Site Characteristics

Specific information regarding the physical characteristics of the site, including topography and drainage, soils and geology, hydrology, and ecological characteristics, is contained in the LF-5 and Zone 1 Remedial Investigation (RI) reports (Weston 1992a and Weston 1993a).

Topography

Before landfill closure, LF-5 sloped generally northward from a high of approximately 100 ft mean sea level (MSL) in the south to approximately 60 ft MSL to the north (an average 4% slope). Prior to capping, bedrock was exposed in the central portion of the landfill.

Geology/Hydrogeology

The overburden deposits across Zone 1 include younger sediments, such as marsh deposits, and older deposits, such as glacial-marine deposits. The stratigraphic units identified at Pease AFB are fill, upper sand, marine clay and silt, lower sand, and glacial till. One or more of these units may be absent at any particular location. The upper sand ranges in thickness from 0 to 19 ft across Zone 1. The marine clay and silt occurs as discontinuous lenses ranging in thickness from approximately 0.6 to 10 ft across Zone 1. The lower sand unit is not prevalent in Zone 1 due to the limited presence of the marine clay and silt unit across Zone 1. Glacial till is discontinuous across Zone 1 and is not present over portions of LF-5.

The topography of the bedrock surface across Zone 1 is accentuated by several prominent highs and one prominent valley, with up to 75 ft of relief zonewide. A relatively large, broad bedrock high extended from the PCDA north toward LF-5, with an outcrop forming a small circular knob in central LF-5. The bedrock consists

of rocks of the Eliot Formation, which is generally composed of interbedded phyllite, metagraywacke, and quartzite.

The saturated overburden material in Zone 1 includes fill, upper sand, marine clay and silt, lower sand, and glacial till. However, at many locations across the zone, the overburden is unsaturated and the water table occurs in shallow bedrock. Because the shallow bedrock is relatively permeable and is not separated from overburden deposits by a significant, continuous aquitard, the shallow bedrock is considered to be part of the water-table aquifer. Thus, the overburden and shallow bedrock are considered to be a single water table unit.

Groundwater beneath LF-5 is recharged primarily from the south; however, a local groundwater mound, which acts as an enhanced recharge zone, is located just south of the landfill over the northern edge of the PCDA and the western edge of the BFSA (Figure 2.1-2). Though Figure 2.1-2 specifically represents overburden groundwater flow during the spring, it is representative of the general flow patterns associated with the site. Groundwater flows radially away from the recharge area. A north/south-trending groundwater divide transects LF-5, resulting in additional groundwater flow (bedrock and overburden) west toward Flagstone Brook and east towards the Railway Ditch.

Depth to groundwater for the water table unit wells associated with LF-5 range from approximately 1.5 to 26 ft bgs, with some wells occasionally having no water present. Tidal fluctuation in water table wells near LF-5 are in the range of 0.05 to 0.15 ft.

Surface Water

The LF-5 surface drainage system consists of two main drainage channels. The first, Flagstone Brook, has its headwaters at the North Ramp/aircraft parking apron and flows northward forming the western boundary of LF-5. The second, the Railway Ditch, flows northward along the eastern border of LF-5, eventually joining Flagstone Brook, approximately 3,000 ft north of LF-5. Flagstone Brook eventually drains to Little Bay to the north of Pease AFB.

Areas of Contamination

RI reports for LF-5 and IRP Zone 1 were completed in April 1992 and October 1993, respectively. The LF-5 RI documented the presence of buried wastes and contamination in soil, groundwater, surface water and sediment in the areas surrounding the landfill. The Zone 1 RI confirmed much of the earlier information reported in the LF-5 RI and provided additional insight into the hydrogeologic conditions at the site; however, it was focused primarily on other sites in Zone 1, including the PCDA, LF-2, LF-4, Flagstone Brook, and Pauls Brook.

The conceptual model of the LF-5 site presented in these RI reports included the following components:

- Several primary contaminant source areas were identified within the landfill; secondary source material, consisting of contaminated soil, was also identified.
- Groundwater beneath the landfill was contaminated with aromatic volatile organic compounds (VOCs), halogenated VOCs, and, to a lesser extent, semivolatile organic compounds, metals, and pesticides. New Hampshire Ambient Groundwater Quality Standards (AGQS) were exceeded for a small number of VOCs, including trichloroethene (TCE), tetrachloroethene (PCE), and benzene; and metals (arsenic, beryllium, chromium, and nickel), primarily in the shallow groundwater associated with the water table.
- Groundwater flow was determined to flow semi-radially away from a localized recharge area in the central portion of the landfill; most of the groundwater appeared to discharge into the adjacent surface water features (Railway Ditch, Flagstone Brook); however, some underflow was identified, particularly in upstream reaches near the southern end of the landfill.

- A plume of halogenated VOCs was migrating eastward from the southeast portion of the landfill, beneath the Railway Ditch and toward LF-3; the source of this contamination was believed to exist in the waste disposal trenches in the southeastern portion of LF-5.
- Surface water and sediment in both Railway Ditch and Flagstone Brook were affected by releases of contamination (through runoff and groundwater discharge) from LF-5. Contamination in Flagstone Brook was also attributed to other sources in Zone 1 and the northern portion of the Flightline

2.1.2 ROD Summary and Remedial Objectives

The remedial action at LF-5 is governed by two RODs: the LF-5 Source Area ROD and the Zone 1 ROD (Weston 1993b and Weston 1995). The LF-5 Source Area ROD primarily addresses soil, debris, surface water, and sediment. The Zone 1 ROD primarily addresses contaminated groundwater associated with LF-5.

2.1.2.1 Landfill 5 Source Area ROD

RODs identify the remedial action objectives (RAOs) which define the scope and purpose of the cleanup action. After the remedial action has been implemented, the RAOs effectively serve as the baseline against which monitoring or performance data are measured. The following RAOs were identified in the LF-5 ROD:

- Prevent or minimize risks to ecological receptors resulting from exposure to contaminated sediment in the Railway Ditch and associated wetlands or to contaminated soil and debris associated with LF-5
- Prevent or minimize risks to humans resulting from exposure to contaminated soil or debris associated with LF-5
- Minimize further migration of contaminants from the LF-5 source area into the groundwater or surface water

To accomplish these objectives, the LF-5 ROD specified a *source control remedy* having the following components:

- Excavation and consolidation/disposal of Railway Ditch sediments into LF-5 that contained contaminants at concentrations exceeding site-specific cleanup goals
- A plan to excavate soil and debris from Landfills 2 and 4, with consolidation/disposal into LF-5 prior to its closure
- Excavation of soil and landfill debris from LF-5 that would be in contact with groundwater (after placement of excavated material from other sites and capping); excavated areas would be backfilled with clean fill to a level 2 ft above the water table (as measured after capping)
- Re-grading and capping of LF-5 with a composite barrier cap designed to meet Resource Conservation and Recovery Act (RCRA) Subtitle C cap performance standards
- Conducting long-term monitoring (including five-year reviews) and placement of institutional controls (deed restrictions) to restrict future activities on the capped area

2.1.2.2 Zone 1 ROD

The Zone 1 Remedial Investigation/Feasibility Study (RI/FS) focused on a number of sites and contaminated media in the zone, including Landfills 2 and 4, the PCDA, Flagstone Brook, Pauls Brook, and groundwater at LF-5. Evaluation of the risk assessment results and other data from the RI/FS resulted in the focusing of the Zone 1 response action on contaminated groundwater associated with LF-5. Landfills 2 and 4 did not require further action under CERCLA, and their closures under state rules were addressed by excavating and consolidating the fill and debris from them into LF-5. Additionally, the PCDA did not require any further action

under CERCLA. Because several issues regarding surface water and sediment quality in Flagstone Brook and Pauls Brook were raised by EPA and NHDES, these surface water bodies were separated from the Zone 1 remedy selection process (see Section 3.0 for discussion). The remedial action objectives (RAOs) identified in the Zone 1 ROD include the following:

- Protect human receptors from exposure to contaminated groundwater that may present unacceptable health risks
- Comply with chemical specific applicable or relevant and appropriate requirements (ARARs) and/or attain background levels for specific contaminants in groundwater

The Zone 1 ROD specified a *management of migration remedy* to address dissolved-phase contamination at LF-5, including contamination within the LF-5 boundary and that which had migrated beyond its footprint. Specific components of the action included:

- Natural attenuation and biodegradation of residual-contaminated groundwater in Zone 1
- Placement of deed restrictions on future use of groundwater in Zone 1 in the vicinity of the LF-5 source area
- Establishment of a Groundwater Management Zone (GMZ) in Zone 1 in the vicinity of the LF-5 source area
- Long-term environmental monitoring in the zone to allow the continued evaluation of the magnitude of contamination , including groundwater, surface water, and sediment sampling and analysis

2.1.3 Standards Assessment (ARARs)

The LF-5 ROD listed media-specific cleanup goals. These goals were either regulatory-based criteria (chemical-specific ARARs) or set at risk-based concentrations calculated using site-specific exposure scenarios or at background levels. Risk-based concentrations were generally used where ARARs either were not available or based on exposure scenarios inconsistent with current/future scenarios at LF-5. ARARs identified in the LF-5 and Zone 1 RODs remain current, with the exception of New Hampshire Groundwater Protection Rules, Env-Ws 410, which were superceded by Env-Wm 1403 in February 1999. The changes in regulatory standards made by Env-Wm 1403 have no negative effect on the selection and current protectiveness of the remedial action implemented for LF-5 groundwater by the Zone 1 ROD. Additionally, no new state or federal laws have been enacted which may call into question the selection and protectiveness of the implemented remedies at LF-5 and Zone 1. The following cleanup goals were identified:

- **Soil** – The Landfill 5 ROD identified soil cleanup goals that were used to guide the excavation, consolidation and capping of the landfill wastes and soils but which are not used during post-closure care activities; soil cleanup goals are not discussed further in the Post Closure Maintenance and Monitoring Plan (PCMMP).

- **Groundwater** – Treatment goals for groundwater generated through dewatering purposes during remedial construction activities were listed in the LF-5 ROD. The Zone 1 ROD identified cleanup goals for LF-5 groundwater, generally based on established ARARs [maximum contaminant levels (MCLs) or AGQS] or background concentrations (for inorganics). Separate goals were identified for overburden (water table) and bedrock groundwater (Table 2.1-1).

- **Surface water** – Cleanup goals for surface water in the Railway Ditch were presented in the LF-5 ROD. Potential risks to human health and the environment from surface water and sediment associated with Flagstone Brook and Pauls Brook were addressed in a consolidated RI/FS and ROD for these Zone 1 surface water bodies and two surface water bodies in Zone 3 (Lower Newfields Ditch and McIntyre Brook). The surface water cleanup goals were based on ARARs [New Hampshire Ambient Water Quality Criteria (AWQC)]. Surface water cleanup goals are shown in Table 2.1-2.

- **Sediment** – The LF-5 ROD identified sediment cleanup goals for the Railway Ditch (Table 2.1-3). Sediments exceeding these criteria were excavated from Railway Ditch.

Following completion of the excavation, consolidation, and capping activities for LF-5, the cleanup goals serve as the performance criteria for evaluation of the natural attenuation process, as a measure of the effectiveness of the final cover system on the landfill, and in general, as a means to verify attainment of the RAOs identified for the landfill and Zone 1.

2.1.4 Remedial Actions

IT Corporation was contracted by Air Force Center for Environmental Excellence (AFCEE) to excavate and relocate landfill debris, soils, and sediments from LFs -2 and -4 and areas adjacent to the railway ditch to LF-5. These activities took place between December 7, 1993 and June 5, 1995. Additionally, IT constructed a lined sedimentation basin to receive groundwater, site runoff, and water pumped from the excavation. Relocated waste was consolidated by IT above the predicted seasonal high groundwater level. An intermediate cap was constructed to cover debris as a precursor to Phase II final cap construction performed by Bechtel. A more detailed description of this work is presented in the *Draft Final Report, Excavation and Relocation of Waste, Soil, and Sediments, Landfills 2, 4, and 5, Pease AFB, New Hampshire* (IT 1995).

During a second phase of the LF-5 remedial action, Bechtel consolidated additional debris and waste soils from LF-6 (as specified in the Zone 4 ROD), the Underground Storage Tank (UST) Flightline area, Site 34 (as specified in the Explanation of Significant Difference for the Site 34 Source Area ROD), and Site 72 into LF-5. Following consolidation, Bechtel prepared the subgrade and capped LF-5 with a composite-barrier-type final cover system to minimize water infiltration and prevent contact between landfill debris and either human or ecological receptors. After completion of capping, piezometers, landfill gas monitoring probes and vents, and survey monuments were installed as specified in the design. This phase of the remedial action was implemented between May 1995 and July 1996. Details from the second phase of the remedial action are documented in the *Landfill 5 Remedial Action Report* (Bechtel 1996).

2.1.5 Remedial Action Performance Summary

An assessment of the performance of the remedial actions completed for LF-5 and Zone 1 must consider a number of distinct yet interrelated elements, namely the final cover system, groundwater elevations beneath the landfill, groundwater quality, surface water and sediment quality, and the GMZ. Each of these is discussed below.

Landfill Cover System

The LF-5 final cover system is intact and functioning as designed to isolate the solid wastes within the landfill. Quarterly inspections of the final cover system began in January 1997. These inspections are comprehensive in nature, addressing all aspects of the cap and related systems necessary to maintain the continued performance of the engineered containment system at the site. The inspections have identified several minor problems that have been resolved by the Air Force. No significant problems potentially affecting the integrity of the final cover system have been identified. The inspections have documented a fairly stable environment at the site, with little variation other than what would be expected from the change in seasons or weather.

Inspection results and examination of current conditions at LF-5 clearly demonstrate that closure of the facility was both properly designed and constructed. All components of the closure action are functioning as intended throughout the year. The site and surrounding areas have stabilized and vegetation is well established following the extensive earthwork and related construction activities associated with the closure. In response to these findings, the inspection frequency was reduced to semiannually (spring and fall), beginning in 1999.

2.1.5.1 Groundwater Elevations Beneath the Landfill

One of the RAOs for LF-5 was to relocate landfill wastes above the water table. Twelve piezometers were installed across the landfill to allow for mapping of the water table elevation beneath the capped waste mass. Water levels are collected on a semiannual basis from these 12 piezometers and the 17 monitoring wells used for groundwater quality monitoring (the piezometers are not sampled). There has been no evidence of saturated waste since December 1996, shortly after the landfill was closed. None of the water level data collected in 1997 or 1998 showed saturated wastes, indicating that the remedial action was effective and the cap has essentially eliminated infiltration as needed to maintain the water table elevation below the waste mass.

Groundwater Quality

Groundwater monitoring results provide additional performance data for the final cover system and whether the system is successfully meeting the RAO to prevent further migration of contaminants from LF-5 source areas into the groundwater. The primary remedial measure for groundwater in the Zone 1 ROD was to utilize natural attenuation and biodegradation processes to reduce residual contamination levels in the groundwater. A total of 17 monitoring wells (10 overburden and 7 bedrock wells) are currently being used to satisfy post-closure groundwater monitoring requirements for LF-5 and Zone 1.

As documented in the *Proposed Modification to Landfill 5 Post-Closure Monitoring and Maintenance Activities* (Bechtel 1999), overall contamination levels and the frequency of exceedances of groundwater cleanup goals have declined since closure of the landfill. These data show that the cap and other remedial measures have eliminated any further releases of contamination from the landfill, resulting in a significant beneficial effect on groundwater quality beneath the landfill and elsewhere in Zone 1. The data also provide supporting evidence that natural attenuation processes are actively reducing groundwater contamination that previously migrated from LF-5.

2.1.5.2 Surface Water and Sediment Quality

Post-closure surface water monitoring has been conducted at eleven stations in Zone 1, six in the Railway Ditch and five in Flagstone Brook. Sediment monitoring is conducted in Flagstone Brook only as contaminated sediments were removed from the Railway Ditch during the remedial action for LF-5.

Surface water results indicate that some discharge of VOC-contaminated groundwater is still occurring; however, the majority of the detections were in low, estimated concentrations of about 1 ppb or less, indicating that the discharge is not having an appreciable effect on overall surface water quality. Interpretation of surface water and sediment results are complicated by the fact that upstream sources—primarily the northern portion of the Flightline—are also contributing low levels of contamination to Flagstone Brook, including semivolatile organic compounds (SVOCs), metals, and pesticides.

The overall contamination levels in both surface water and sediment are low and generally well below those detected prior to the remedial action; however, further evaluation is warranted.

2.1.5.3 Groundwater Management Zone

RAOs in the Zone 1 ROD were focused on preventing exposure to contaminated groundwater and (eventually) attaining groundwater cleanup goals. These objectives were to be accomplished through a combination of natural attenuation with institutional controls and long-term monitoring. One component of the remedy was to establish a GMZ in the vicinity of the Landfill 5 source area. NHDES regulations governing GMZs restrict groundwater usage within the zone and establish both monitoring and performance requirements for groundwater. Implementation of these requirements by the Air Force satisfies the RAOs identified in the Zone 1 ROD for protection of human health and groundwater cleanup.

2.1.5.4 Performance Evaluation Summary

Post-closure inspections, monitoring of groundwater, surface water and sediment, and water level measurements collected across LF-5 and Zone 1 show that closure of the landfill has been highly successful in hydraulically and physically isolating the LF-5 waste mass. Residual levels of contamination are present in groundwater but generally well below ROD cleanup goals or other criteria and natural attenuation processes are contributing toward the eventual elimination of even these residual levels. These data show that the site is meeting the RAOs identified in the LF-5 ROD:

- The final cover system is functioning as designed to prevent exposures to contaminated soil and debris and thus minimize current or future risks to human or ecological receptors.
- Remedial construction activities completed for the closure action have successfully relocated landfill wastes above the water table and effectively eliminating infiltration, thereby minimizing any further release of migration of contaminants from the LF-5 source area into groundwater or surface water.
- Establishment of a GMZ and monitoring of groundwater in compliance with the relevant NHDES requirements effectively protects human receptors from exposure to contaminated groundwater.
- A comprehensive monitoring program during the post-closure care period has identified declining groundwater contamination levels and significant progress toward the goal of attaining chemical-specific ARARs or background levels for contaminants of concern in groundwater.

Another RAO for LF-5 addressed contaminated sediment in the Railway Ditch. As stated above, contaminated sediments were excavated from the ditch and consolidated within LF-5. This action satisfied the RAO to prevent or minimize risks to ecological receptors resulting from exposure to contaminated sediments within the Railway Ditch.

2.1.5.5 Areas of Noncompliance

There is no indication that site-related contamination exceeding media-specific cleanup goals is migrating offsite (beyond the GMZ boundary) from LF-5. All other components of the remedial action are functioning as designed. Thus, there are no known areas of noncompliance.

2.1.6 Statement of Protection of Human Health and the Environment

The remedy at LF-5 remains protective of human health and the environment. The remedy also is cost-effective and complies with ARARs.

The LF-5 remedial activities have and continue to permanently reduce the risks to human health and environment by eliminating, reducing, or controlling exposures to human and environmental receptors through engineering controls and natural attenuation. The principal threats at LF-5 are human and ecological receptor contact with landfill debris and leaching of organic and inorganic chemicals into the groundwater. The addition of an impermeable cap to the landfill has greatly reduced the possibility of human or ecological receptor contact with the debris. The impermeable cap has also reduced the leaching of chemicals into the groundwater. Natural attenuation has, and will continue to, reduce the concentration of groundwater contaminants thus reducing the potential for human exposure to contaminated media.

2.1.7 Recommendations

No change in land use for this site is forecast, therefore the remedial measures remain appropriate and protective of human health and the environment. Annual evaluation of environmental monitoring should continue and be used as a means of identifying opportunities to refine long-term monitoring activities.

2.1.8 References

Bechtel (Bechtel Environmental, Inc.), 1998. *United States Air Force, Installation Restoration Program, Pease Air Force Base. Landfill 5 Annual Report.* April.

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2.1.8 References

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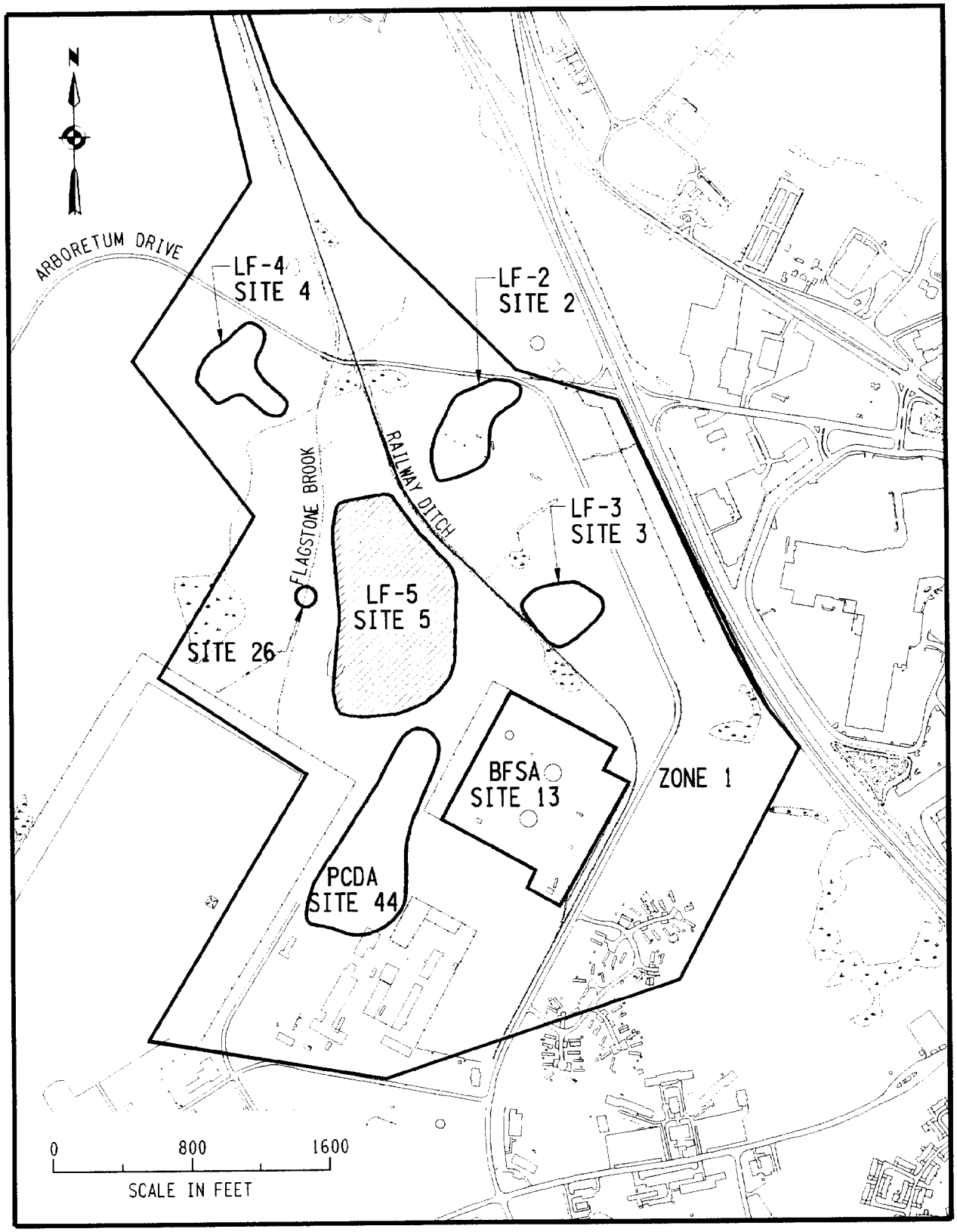
Weston, 1995. *United States Air Force, Installation Restoration Program, Pease Air Force Base. Zone 1 Record of Decision.* July.

Table 2.1-3
Sediment Cleanup Goals
Landfill 5

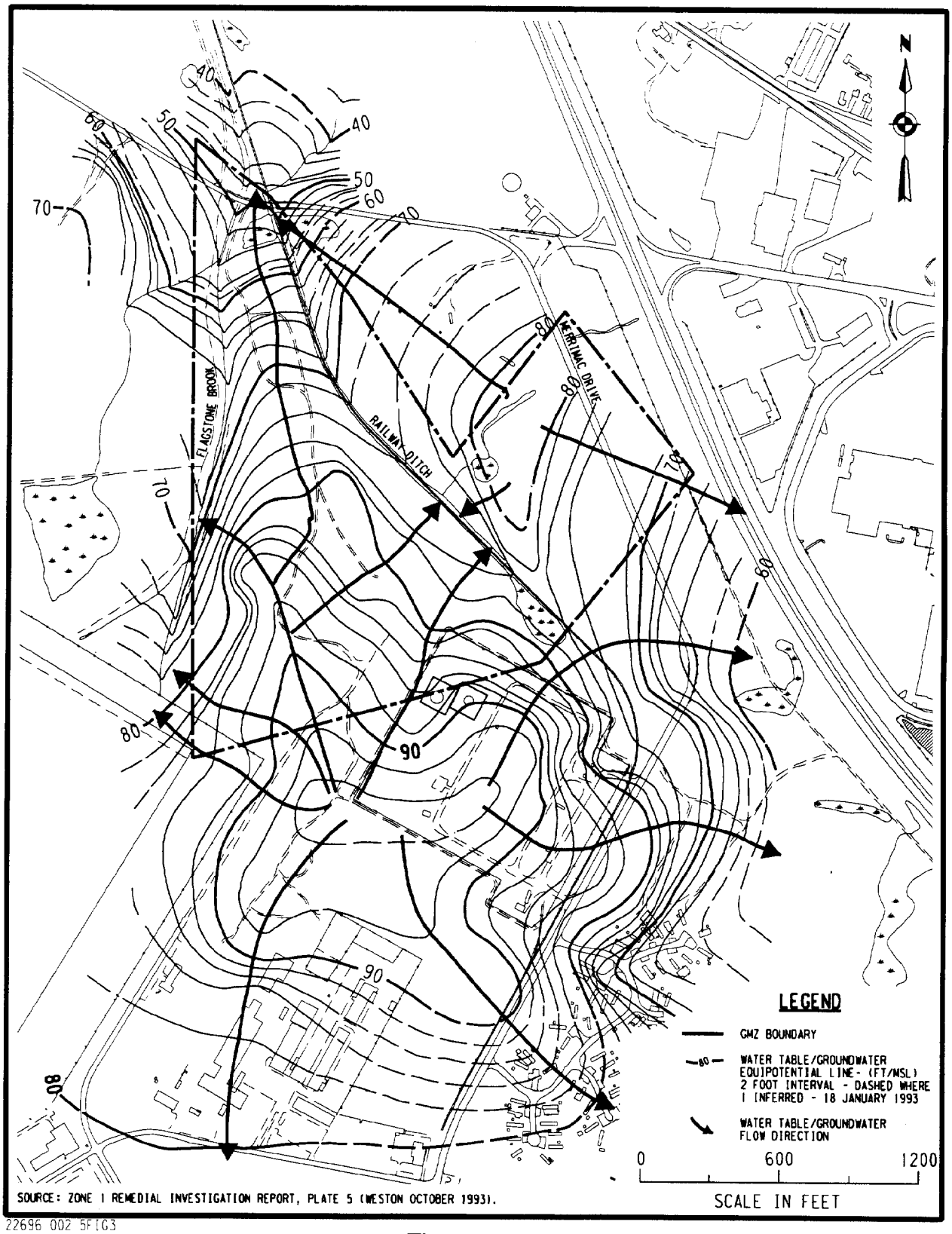
Compound	Railway Ditch (mg/kg)
Organics	
a-Chlordane	0.0005
g-chlordane	0.0005
4,4'-DDD	0.002
4,4'-DDE	0.002
4,4'-DDT	0.001
Acenaphthene	0.15
Benzo(a)anthracene	0.23
Chrysene	0.4
Dibenzo(a,h)anthracene	0.06
Fluoranthene	0.6
Phenanthrene	0.225
Pyrene	0.35
Total PAHs	4
Inorganics	
Antimony	2
Arsenic	33
Lead	35
Nickel	30
Zinc	120

Source: LF-5 ROD (Weston 1993b)



J:/22636/002/EF1G1-1.3GN

Figure 2.1-1
Landfill 5 Site Location
Pease AFB, NH



22696 002 5F1G3
6/27/96

Figure 2.1-2
Site 5, Landfill 5
Qualitative Flownet and Groundwater Elevations
Pease AFB, NH

2.2 ZONE 2

2.2.1 Introduction

2.2.1.1 Site Location and Description

Zone 2 is located in the northwestern portion of Pease AFB and contains six sites investigated under the Air Force's IRP as required under CERCLA (Figure 2.2-1). The sites include Site 1 (Landfill 1 or LF-1), Site 7 (Fire Department Training Area 1 or FDTA-1), Site 10 (Leaded Fuel Tank Sludge Area or LFTS), Site 22 (Burn Area 1 or BA-1); Site 37 (Burn Area 2 or BA-2); and Site 43 (McIntyre Road Drum Disposal Area or MRDDA). The remedial approach in Zone 2 involves in situ treatment of the Site 22 source area by soil vapor extraction/air sparging (SVE/AS), institutional controls restricting future use of Zone 2 groundwater, natural attenuation of zone-wide groundwater contamination, and long-term monitoring. The Zone 2 ROD specified no action (for source control) under CERCLA for LF-1, FDTA-1, LFTS, BA-2, and MRDDA. These no-action sites will not be discussed further in this document except in the context of their role in the monitoring and attenuation of zone-wide groundwater contamination.

The area west of McIntyre Road, including LF-1 and MRDDA, has been transferred to the U.S. Fish and Wildlife Service and is operated as part of the Great Bay National Wildlife Refuge; the area is largely wooded and contains Upper and Lower Peverly Ponds and Bass Pond. Between McIntyre Road and the runway to the east lie the two former burn areas (BA-1 and BA-2), FDTA-1, and the LFTS area. The eastern portion of the Zone is under the jurisdiction of the Pease Development Authority (PDA) to support airport operations. Much of the area east of McIntyre Road has been cleared of vegetation to comply with the operational requirements of navigational equipment installed near the LFTS and BA-2.

2.2.1.2 Site History and Contaminant Sources

The CERCLA response actions at Zone 2 were designed to address the principal threat posed by leaching of contaminants to groundwater at Site 22 (BA-1) and the associated groundwater contaminant plumes that encompass the LFTS/BA-1/MRDDA and BA-2 areas of concern. The following discussion summarizes relevant data concerning the type and scope of historical activities reportedly responsible for the release of contamination to the environment at these 4 sites.

Site 10 (LFTS):

Site 10 consists of two separate areas on the eastern and western sides of Nottingham Road, both within approximately 300 ft of Site 22 (Figure 2.2-1). From the late 1950s to 1978, Site 10 was used for disposal of sludge obtained from leaded aviation gasoline tank cleaning operations conducted at the onsite BFSA. An estimated 350 gallons of sludge containing water, rust, residual fuels, fuel sludge, and residue from sand blasting tank interiors was generated during the approximately 20-year disposal period.

Site 22 (BA-1):

Site 22 is located in the central portion of Zone 2 (Figure 2.2-1). Between 1954 and 1976, Site 22 was reported to have been used as a fire training area and a site for burning spent fuel solvents. The primary contaminant source was found to consist of two circular areas characterized by blackened or stained surface soil with little or no vegetation.

Site 37 (BA-2):

Site 37 is located southwest of Site 10, adjacent to the eastern side of McIntyre Road (Figure 2.2-1) and covers approximately 3.4 wooded acres surrounding roughly circular areas characterized by blackened surface soil with

little or no vegetation. Site 37 is a suspected former fire training area or waste solvent burn area. Although the exact period of use is not certain, it is estimated that fire training or waste solvent burn activities commenced between 1954 and 1960 and ended before 1976, based on aerial photographs.

Site 43 (MRDDA):

The MRDDA is located on the western side of McIntyre Road, opposite Site 22. Little information is available concerning the history and use of the site. A cluster of 55-gal drums and 5-gal cans were partially exposed at the surface, and the area was suspected to be the site of historic subsurface disposal activities. Investigation activities did not find any evidence of subsurface disposal, and it was concluded that the MRDDA was not a contaminant source area.

2.2.1.3 Summary of Site Characteristics

An overview of the physical characteristics of Zone 2 is provided in the following sections; more detailed information regarding the topography, hydrology, geology, etc., is contained in the *Zone 2 Remedial Investigation Report*, *Feasibility Study*, and *Record Of Decision* (ROD) (Weston 1993a, 1993b, and 1995).

Topography

The southeastern section of Zone 2 contains the highest elevation within the zone at greater than 110 ft MSL. This area is situated on a bedrock high that controls local topography. Slopes dip away from this high to the northwest and north, and to the west toward the Peverly Ponds, where the lowest elevation (35 ft MSL) of the zone exists. Topographic lows correspond to wetlands associated with the Peverly Ponds. Topography in the eastern part of Zone 2 has been altered, presumably during construction of the runway, with some areas showing evidence of fill, while others have been excavated. Bedrock outcrops were observed between 59 and 65 ft MSL on the slopes east of the Peverly Ponds and south of Nottingham Road.

Site 10 is a relatively flat area. Site 22 has little topographic relief and no obvious surface drainage pathways. Site 37 also exhibits little topographic relief.

Geology/Hydrogeology

The native overburden deposits in Zone 2 consist of the US, which is underlain successively by the marine clay and silt, lower sand, and glacial till. Fill material overlies the upper sand at some locations, primarily at LF-1, Site 43, and areas of the zone bordering the runway. One or more of these units may be absent at any particular location. The thickness of the overburden is thin to absent to the west and southwest of Site 43 and the maximum overburden thickness is along the eastern border of the zone, where the bedrock surface drops sharply.

The bedrock in Zone 2 consists primarily of the Eliot Formation, composed of phyllite, metagraywacke, and quartzite. In general, bedding strikes northeast with steep dips to the northwest. Open fractures are abundant in shallow bedrock and open fracture densities decrease significantly in deeper bedrock.

Groundwater occurs in both overburden and bedrock underlying Zone 2. The major water-bearing units are the upper sand, lower sand, and BR. The water table is typically present in the upper sand unit during periods of high water levels (spring) and the upper sand and marine clay and silt units during periods of low water levels (fall/winter). The marine clay and silt unit appears to be a confining layer in some areas but is absent in other areas. The relatively flat topographic high in the central portion of Zone 2, typically coarse and permeable surface soil, and the lack of surface drainage features indicate that some groundwater recharge does occur across the site. To the north and west of the topographic high, the ground surface slopes toward the Peverly Ponds. The groundwater in the overburden flows generally to the northwest and southeast due to a groundwater divide

(Figure 2.2-2). The groundwater in the bedrock is generally western to southwestern (Figure 2.2-3). Much of the low-lying portion of Zone 2 consists of ponds and wetlands, points of groundwater discharge.

Surface Water

Portions of Zone 2 are located in the Peverly Brook drainage system within the Great Bay watershed (Figure 2.2-4). Although the primary areas of concern within Zone 2—Sites 10, 22, and 37—drain towards McIntyre Brook (Bechtel 1998a), a potentially significant portion of the groundwater beneath these sites appears to flow towards eventual discharge in the Peverly and Bass Ponds. Surface water and sediment monitoring of McIntyre Brook was addressed in the Brooks and Ditches ROD (Weston 1997) and will be discussed in Section 3.1 of this report.

The Peverly Brook drainage is composed primarily of three manmade ponds. From upstream to downstream they are Upper Peverly Pond, Lower Peverly Pond, and Bass Pond. Defined channels are located between McIntyre Road and Upper Peverly Pond, and between Lower Peverly Pond and Bass Pond. Surface water from Bass Pond discharges directly into Great Bay. Surface flow on the eastern side of Peverly Brook is toward the west where there are seeps and drainage areas. Wetlands have been identified bordering the surface water bodies.

Areas of Contamination

Free product

A localized accumulation of free-phase product detected at Site 22 has acted as a source of groundwater and soil contamination. Recent evaluation of free-phase product shows decreasing presence of product within the source area of Site 22 (Figure 2.2-5).

Soil

The source areas of concern within Zone 2 consist of contaminated soils at Sites 22, 37, and 10. While the soil in the unsaturated zone at these locations contained only negligible levels of contamination, the saturated soils in these areas were found to have relatively significant amounts of residual contamination, including benzene, toluene, ethylbenzene, and xylenes (BTEX) and total petroleum hydrocarbons (TPHs). The highest levels of contamination typically occur at the upper sand/marine clay and silt interface (Weston 1995).

Groundwater

Aromatic hydrocarbons in the form of BTEX are the primary contaminants of concern in the overburden groundwater, while benzene is the primary contaminant of concern in bedrock groundwater. Other organic contaminants, including ethylene dibromide, naphthalene, and TCE, have been detected at scattered locations across Zone 2 at concentrations exceeding the New Hampshire AGQS. These contaminants appear to be more prevalent near known source areas; however, these source areas do not appear to have generated any spatially significant dissolved phase plumes. Low concentrations of metals (arsenic, manganese, and lead) have also been detected with isolated exceedances of the New Hampshire AGQS.

Overburden BTEX plumes emanate from source areas at Sites 10, 37, and 22. Figures 2.2-6 and 2.2-7 show the contaminant contours from the spring 1998 sampling for Site 22 and Sites 10/37, respectively. BTEX contamination at Site 37 appears to be restricted to a small area in the overburden only. Tables 5-2 through 5-5 in the *Zone 2 Annual Report for 1998* presents the groundwater sampling data from 1988 through 1998 (Bechtel 1999). Groundwater contamination associated with these sites is completely within the groundwater monitoring zone boundary. The majority of the overburden groundwater contamination is in close proximity to the source areas and only a few isolated areas of bedrock groundwater contamination exceeding cleanup goals have been detected during recent monitoring.

Surface water/sediment

Surface water in the Peverly and Bass ponds does not appear to have been significantly impacted by past practices in Zone 2. Sediment samples have contained pesticides and metals above background levels. The pesticides (mostly DDT and its degradation products) reflect pesticide usage in agricultural applications prior to development and routine applications of pesticides at recreational and mosquito breeding areas by the Air Force during base operations. The source of the metals contamination is also unlikely to be related to Zone 2 given the absence of appreciable inorganic source material in any Zone 2 sites, although seeps identified along Upper Peverly Pond identified elevated levels of metals in the surface water and sediment that may provide a limited source of these contaminants to Upper Peverly Pond. It is likely that the presence of elevated metals in the sediment most likely is due to the propensity for these constituents to accumulate and concentrate within the sediment matrix where organic matter and Eh and pH conditions favor precipitation and/or sorption of metals.

2.2.2 ROD Summary and Remedial Action Objectives

The baseline risk assessment completed as part of the RI process for Zone 2 identified adverse human health risks for future groundwater users in areas associated with the contaminant plumes at Sites 22, 10, and 37. Minimal ecological risks were identified for soils at LF-1 and BA-2 and surface water and sediment in the Peverly Brook drainage system.

The Zone 2 ROD identified RAOs which defined the scope and purpose of the cleanup action needed to mitigate the potential threats to human health and the environment identified in the Baseline Risk Assessment. After the remedial action has been implemented, the RAOs continue to serve as a metric against which the monitoring and performance data are measured.

The following site-specific RAOs were developed for Zone 2:

- Site 10 – No RAOs were established for soil because there were no exceedances.
- Site 22 – Remove light nonaqueous-phase liquid (LNAPL) and residual product from Site 22 soil. No soil cleanup goals are specified. The RAO for Site 22 soils is to remove contamination mass in the soils to the extent practicable for the SVE/AS system (system performance evaluation), using NHDES soil policy as a reference baseline.
- Site 37 – No RAOs were established for soil because the extent of contamination is limited.
- Groundwater:
  - Protect human receptors from contaminated groundwater that may present an unacceptable health risk (total cancer risk greater than 10^{-4} or a hazard index of greater than 1).
  - Comply with chemical-specific, regulatory-based remedial objectives (ROs).
  - Prevent contaminated groundwater from affecting surface water quality.
  - Protect against potential leaching of soil contaminants from Site 22 soils to groundwater at levels that could cause exceedances of groundwater ROs.
- Surface water and sediment – Monitoring of surface water and sediment quality over time in Upper and Lower Peverly and Bass ponds.

To accomplish these objectives, the Zone 2 ROD specified a source control remedy for Site 22 and a combination of institutional controls and natural attenuation for zone-wide groundwater; components of the remedial action are discussed below.

SVE/AS System

In situ SVE/AS treatment of Site 22 source area and LNAPL and treatment of extracted soil vapor for removal of VOCs.

Institutional Controls

Establishment of institutional controls restricting the future use of Zone 2 groundwater, including a GMZ, and conducting long-term GMZ monitoring.

Natural Attenuation

During and following the completion of SVE treatment of source area and LNAPL removal, enhanced by injection of air below the water table, groundwater quality will be remediated by natural attenuation.

Long-term Monitoring

Long-term environmental monitoring, including zone-wide groundwater and surface water, sediment, and fish tissue in Upper and Lower Peverly and Bass Ponds. This process is being implemented through an EPA and NHDES approved Long-Term Monitoring Plan (Bechtel 1997).

2.2.3 Standards Assessment (ARARs)

Cleanup levels were established for contaminants in groundwater, surface water, and sediment within Zone 2. No soil cleanup goals were established for Site 22 soil, as action is a system performance based activity. Tables 2.2-1, 2.2-2, and 2.2-3 summarize the groundwater, surface water, and sediment cleanup goals presented in the Zone 2 ROD (Weston 1995). ARARS identified in the Zone 2 ROD remain current, with the exception of New Hampshire Groundwater Protection Rules, Env-Ws 401, which were superceded by Env-Wm 1403 in February 1999. The changes in regulatory standards made by Env-Wm 1403 have no negative effect on the selection and current protectiveness of the remedial action implemented for Zone 2. Additionally, no new state or federal laws have been enacted which may call into question the selection and protectiveness of the implemented remedy for Zone 2.

2.2.4 Remedial Actions/Systems

The Site 22 remedial system consisting of an SVE/AS treatment system for the source area soils was constructed in the fall of 1996 and spring of 1997, and the system began operation in May of 1997. The remedial system layout is shown in plan view in Figure 2.2-5. The remedial system components are described in the following sections.

AS System

The in situ AS system consists of 10 manifolds piped to a total of 70 vertical AS wells. Fifty-two AS wells are located in the primary area, and 18 AS wells are in the expansion area. Each manifold terminates at a flow control system box containing a pressure indicator, flow indicator, and flow control valve.

The AS system consists of the blower assembly, heat exchanger, manifold, and ancillary items, including flow control valves, pressure, temperature, and flow indicators, and sample ports. The 50-hp blower produces a flow of 540 scfm at a pressure of 11 psig. The AS flow is passed through an air-to-air heat exchanger before being piped to the wellfield.

SVE System

The primary area and expansion area SVE systems consist of the blower assembly, knockout tank, manifold, and ancillary items, including flow control valves, temperature, vacuum, and flow indicators, and sample ports. Two 40-hp blowers produce a flow rate of 1,100 scfm for the primary area and 660 scfm for the expansion area at 9-in. Hg vacuum for the primary area and 11-in. Hg vacuum for the expansion area. Two 40-gal moisture separators were added to the treatment systems to contain any groundwater extracted as part of the SVE process.

The primary area blower system is piped above grade to 8 SVE well manifolds, which contain a total of 34 SVE wells. The expansion area blower system was piped above grade to 10 SVE well manifolds containing a total of 61 SVE wells.

SVE/AS System Operation

The Site 22 system is not operated during the winter months (November-April) due to the exposed nature of the system. During the first year of system operation (1996), the system was operated in a pulse mode involving alternating operation of the system manifolds (half active, half inactive during 12-hour periods). This method was discontinued in 1998 when all manifolds were continuously active. The system is currently being operated in a continuous (non-pulsing) mode for the 1999 season.

2.2.5 Remedial System Performance Summary

2.2.5.1 Site 22

The SVE/AS remedial system at Site 22 is in its third year of operation and has successfully achieved its principal performance goal of removing contamination from the Site 22 source area. A discussion of system performance is presented below.

Contaminant mass removal

SVE/AS treatment of Site 22 source area soil is successfully removing contaminant mass to reduce the leaching of contaminants from soil to groundwater in order to reduce the potential for adverse risks from ecological and human receptor exposure. During the 1997 operational period, approximately 9,920 lb of hydrocarbon were removed by the SVE/AS system. Approximately 14,550 lb of hydrocarbon were removed by the SVE/AS system during the 1998 year of operation. This represents a 47% increase, due in part to the optimization of the SVE flowrates at the 1998 startup to focus SVE on the areas of high contamination. Figure 2.2-8 illustrates the pounds of hydrocarbon removed during the 1997 and 1998 operational periods.

Additionally, LNAPL is collected where it is found to be recoverable. Approximately 5.9 gal were removed during the 1997 operational period (from wells AS-14 and AS-22) and approximately 4.5 gal were removed during the 1998 operational period (from well AS-22).

System performance

Vacuum measurements in the vadose zone indicate that the radius of influence for the Site 22 SVE system fully captures the source area as defined in the RI/FS and subsequent delineation efforts during system construction. Operational parameters for the system are routinely evaluated and modified, as necessary, to optimize the recovery of contaminant mass. As stated above, the amount of vapor contaminant removed by the SVE system

increased 47% from 1997 to 1998 through just such an optimization activity, which in this case involved reducing the SVE flow from relatively clean areas and increasing the flow from more highly contaminated areas.

In contrast to the SVE system, the air sparging system largely has not met design expectations. Specifically, the design flows have not been met in the majority of the air sparging wells, primarily due to the low permeability of the surrounding formation. An evaluation of the system was performed in the spring of 1998 to determine whether the permeability could be enhanced using high-pressure air injection. Results of tests showed that an injection pressure of more than 40 psi was needed to obtain the design flow into the majority of the wells. Pressures of this magnitude were deemed impracticable for full-scale application. The Air Force continues to operate the system as some of the wells are operating properly but the full benefit of the sparge system (induced volatilization of dissolved contaminants) is not being realized, which is likely to impact the overall system performance evaluations in the future.

Groundwater monitoring

Groundwater monitoring is performed to evaluate the effectiveness of the remedial system in meeting the stated RAOs. General trends in the groundwater quality at Site 22, as discussed in the *Zone 2 Annual Report for 1998*, indicate that the remedial system is effectively reducing the release of contamination to groundwater. This reduction of contamination at Site 22 facilitates the overall natural attenuation process for groundwater, which in turn reduces the risks associated with exposure to the groundwater (or surface water into which the contaminated groundwater may discharge). Performance monitoring data that support these findings include the following:

- The contaminant concentrations at several wells in the source area suggest that the remedial approach is impacting the subsurface. Four wells in the Site 22 source area show unambiguous reducing trends over the period of record for both volatile and semi-volatile organic compounds, indicating that the SVE system is having a positive effect in reducing the concentration of organic compounds.
- Mid-plume contaminated wells have had relatively consistent contaminant concentrations. As the source area is remediated, it is expected that the mid-plume concentrations will begin to decline as well.
- Concentrations of contaminants of concern are negligible at the groundwater monitoring zone boundary.
- Intrinsic remediation of the groundwater is occurring.

2.2.5.2 Zone-wide Groundwater

Groundwater monitoring

The remedy for Zone 2 addresses the principal threat posed by contaminated groundwater through the use of institutional controls and by allowing natural attenuation processes to reduce contaminant levels in groundwater. A GMZ has been established and there is no current groundwater use in Zone 2. General trends in the groundwater quality, as discussed in the *Zone 2 Annual Report for 1998*, indicate that natural attenuation processes are reducing contamination levels within the GMZ and the associated risks resulting from potential exposures of Zone 2 to groundwater. Performance monitoring data that support these findings include the following:

- The areal extent of volatile organic groundwater contamination at Site 37 has been reduced and was above cleanup goals for only one well during the 1998 monitoring.
- Concentration of benzene at a source area well at Site 10 has displayed a downward trend over time, although a midplume monitoring well has exhibited an increasing trend in benzene concentrations.

- Biodegradation indicators show that intrinsic remediation is occurring within the Sites 22 and 10 plumes, based on the distribution of key indicators along contaminant migration flowpaths. Because of limited contamination detected in Site 37 wells—only one well contains benzene—no intrinsic remediation analysis has been conducted for this site.

2.2.5.3 Zone-wide Surface Water, Sediment, and Fish Tissue

The ROD requirement for monitoring of surface water, sediment, and fish tissue is designed to collect the information necessary to monitor and evaluate potential threats to human health and the environment posed by contaminants in these media. This monitoring also serves as a means to measure the effectiveness of Zone 2 remedial action. Historical surface water and sediment monitoring in the Peverly Ponds and Bass Pond did not identify any definite impacts attributable to Zone 2 CERCLA sites.

Performance monitoring conducted in accordance with the Zone 2 ROD requirements has shown that surface water and sediment quality has not changed much over time. The contaminants of concern include metals and pesticides for both surface water and sediment and polychlorinated biphenyls (PCBs) for sediment. Metals and pesticides are still being detected in both media and in isolated occurrences exceedances of the ROD cleanup goals have occurred; however, concentrations vary considerably both between stations and between sampling events at the same station. No apparent trends of either increasing or decreasing quality have been identified.

Fish tissue monitoring was conducted in 1996, prior to the implementation of the remedial action at Site 22, and will be conducted again in 2001. The need for continued fish tissue monitoring will be evaluated on the basis of results from the 2001 event. The initial sampling of fish tissues identified low concentrations of pesticides (DDT degradation products) that may present a risk to fish-eating animals (piscivores) but it is unlikely that these contaminants were derived from Zone 2 sites. The tissue samples also contained low concentrations of PCBs and metals. Future fish-tissue monitoring is likely to show similar results given the recalcitrant and lipophilic nature of these contaminants.

2.2.5.4 Areas of Noncompliance

The treatment objectives for the Site 22 SVE/AS system are being met. The natural attenuation processes are working to reduce contaminant levels in the groundwater. There are no known areas of noncompliance.

2.2.6 Statement of Protection of Human Health and the Environment

The Air Force affirms that the remedies for Site 22 and Zone 2 remain protective of human health and the environment. The remediation is reasonably cost-effective, complies with ARARs, and significantly reduces the toxicity, mobility, and/or volume of hazardous substances. Additionally, the remediation utilizes alternative treatment technologies to the maximum extent practicable for these sites (SVE/AS for Site 22).

It is expected that the remedial activities will permanently reduce the risks to human health and environment by eliminating, reducing, or controlling exposures to human and environmental receptors through engineering and institutional controls. The principal threat in Zone 2 is leaching of contaminants from subsurface soil to groundwater. Engineering controls included in the remedy reduce the concentration of subsurface soil contaminants and restrict site access, resulting in reduced potential for human exposure to contaminated media.

2.2.7 Recommendations

The remedial actions for Zone 2 should continue to be implemented in accordance with the EPA and NHDES-approved plans governing system operation, maintenance, and long-term monitoring.

Annual evaluations of system operation and environmental monitoring should continue and be used as a means of identifying opportunities to optimize both the operation of the system (either to accelerate contaminant removal or increase cost-effectiveness) and refine long-term monitoring activities.

Future evaluations of the Site 22 system should attempt to identify a realistic end-point for the remediation based upon system performance or effectiveness tailing off. Such evaluations would consider the quantity and rate of contaminant mass removal, treatment plant operating and maintenance costs, and other related factors. Additionally, future evaluations should also attempt to identify the level of progress toward meeting site- or zone-specific groundwater cleanup goals developed during the remedy decision-making process.

2.2.8 References

Bechtel (Bechtel Environmental, Inc.), 1997. *System Startup and System Long-Term Monitoring Plan.* March.

Bechtel, 1998a. *Basewide Surface Water, Sediment, and Fish Tissue Monitoring.* April.

Bechtel, 1998b. *Operation and Maintenance Plan, Pease AFB.* June.

Bechtel, 1999. *Zone 2 Annual Report for 1998.* April.

Weston (Roy F. Weston, Inc.), 1993a. *Zone 2 Remedial Investigation Report, Pease AFB, NH.* November.

Weston, 1993b. *Zone 2 Feasibility Study Report, Pease AFB, NH.* December.

Weston, 1995. *Zone 2 Record of Decision, Pease AFB, NH.* September.

Table 2.2-1
Groundwater Cleanup Goals
Sites 10, 22, and 37

Compound	Overburden Cleanup Goal (µg/L)	Bedrock Cleanup Goal (µg/L)
Sites 10 and 22		
Organics		
Benzene	5	5
Bis(2-ethylhexyl)phthalate	6	--
1,2-Dibromoethane	0.05	--
Ethylbenzene	700	--
Isopropylbenzene	88.1	--
Methyl isobutyl ketone	350	--
2-Methylnaphthalene	13.4	--
Naphthalene	20	--
Sec-butylbenzene	7.3	--
Toluene	1,000	--
Trichloroethene	5	--
1,2,4-Trimethylbenzene	19.8	--
Inorganics		
Arsenic	50	--
Cadmium	5	--
Lead	15	--
Manganese	942	--
Site 37		
Organics		
Bis(2-ethylhexyl) phthalate	6	--
2-Methylnaphthalene	13.4	--
Trichloroethene	5	--

Source: Zone 2 ROD (Weston 1995)
-- Not Required

Table 2.2-2
Surface Water Cleanup Goals
Zone 2

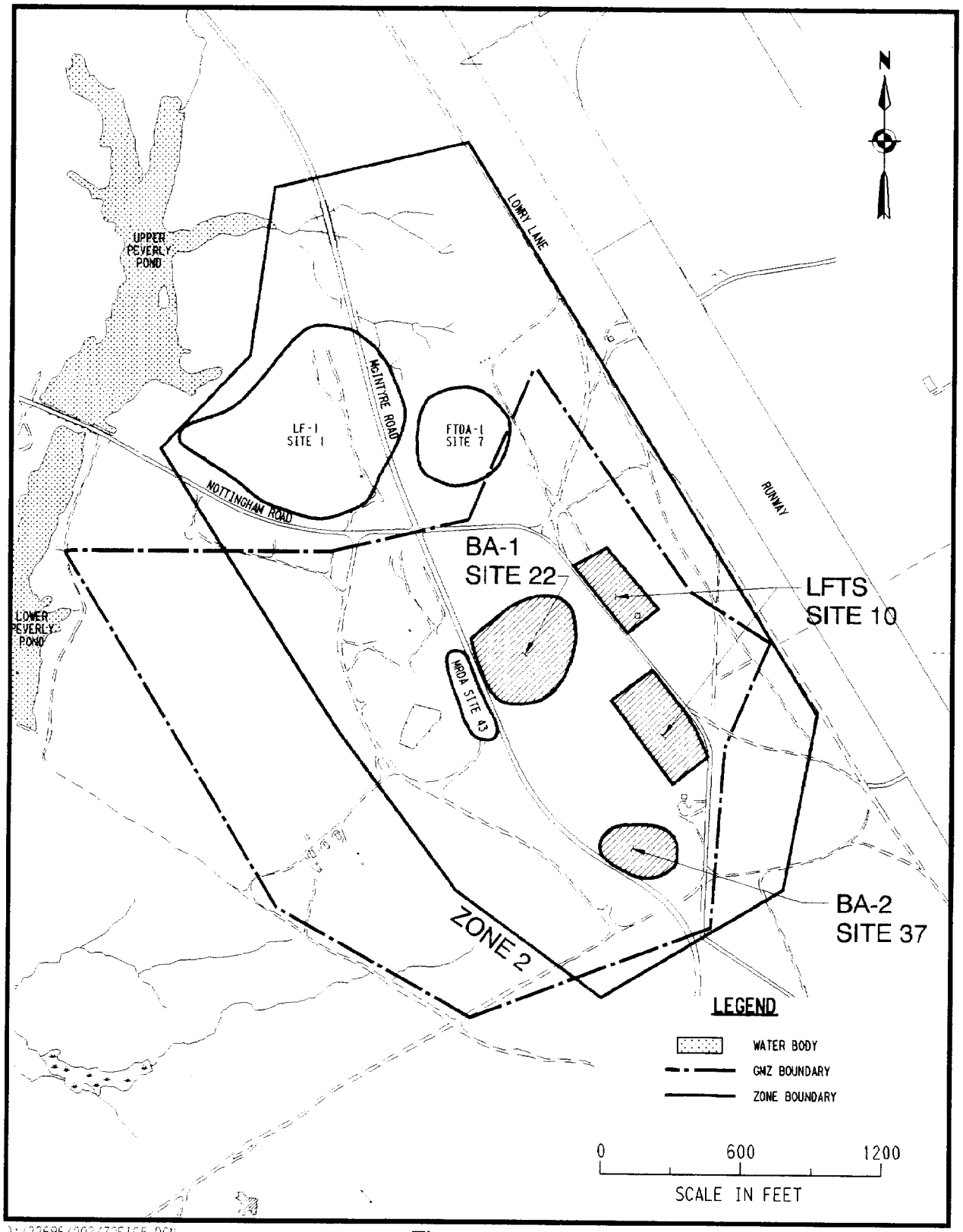
Compound	Upper Peverly Pond (µg/L)	Lower Peverly Pond (µg/L)	Seeps (µg/L)
Arsenic	PQL	PQL	PQL
Aluminum	896	--	--
Cadmium	--	--	PQL
Iron	2,890	--	2,890
Lead	5	--	--
Manganese	1,907	--	--
Zinc	72.9	66	--

Source: *Zone 2 ROD* (Weston 1995)
-- No cleanup goal for this compound.

Table 2.2-3
Sediment Cleanup Goals
Zone 2

Compound	Upper Peverly Pond (mg/kg)	Lower Peverly Pond (mg/kg)	Bass Pond (mg/kg)	Seeps (mg/kg)
Arsenic	33	33	33	33
Lead	42.1	--	--	42.1
Mercury	--	--	--	0.200
Nickel	46.7	--	--	46.7
Silver	--	--	--	1.0
Zinc	120	120	120	--

Source: *Zone 2 ROD (Weston 1995)*
-- No cleanup goal for this compound



D:/22696/002/ZIPFIG5.DGN

Figure 2.2-1
Site Location Map
Zone 2, Sites 10, 22, 37
Pease AFB, NH

D:/22696/002/22FIG1-13.DGN

Figure 2.2-2
Overburden Water Table Elevations - September 1998
Zone 2
Pease AFB, NH

O:/22696/002/Z2FIG-12.DGN

Figure 2.2-3
Bedrock Water Table Elevations - September 1998
Zone 2
Pease AFB, NH

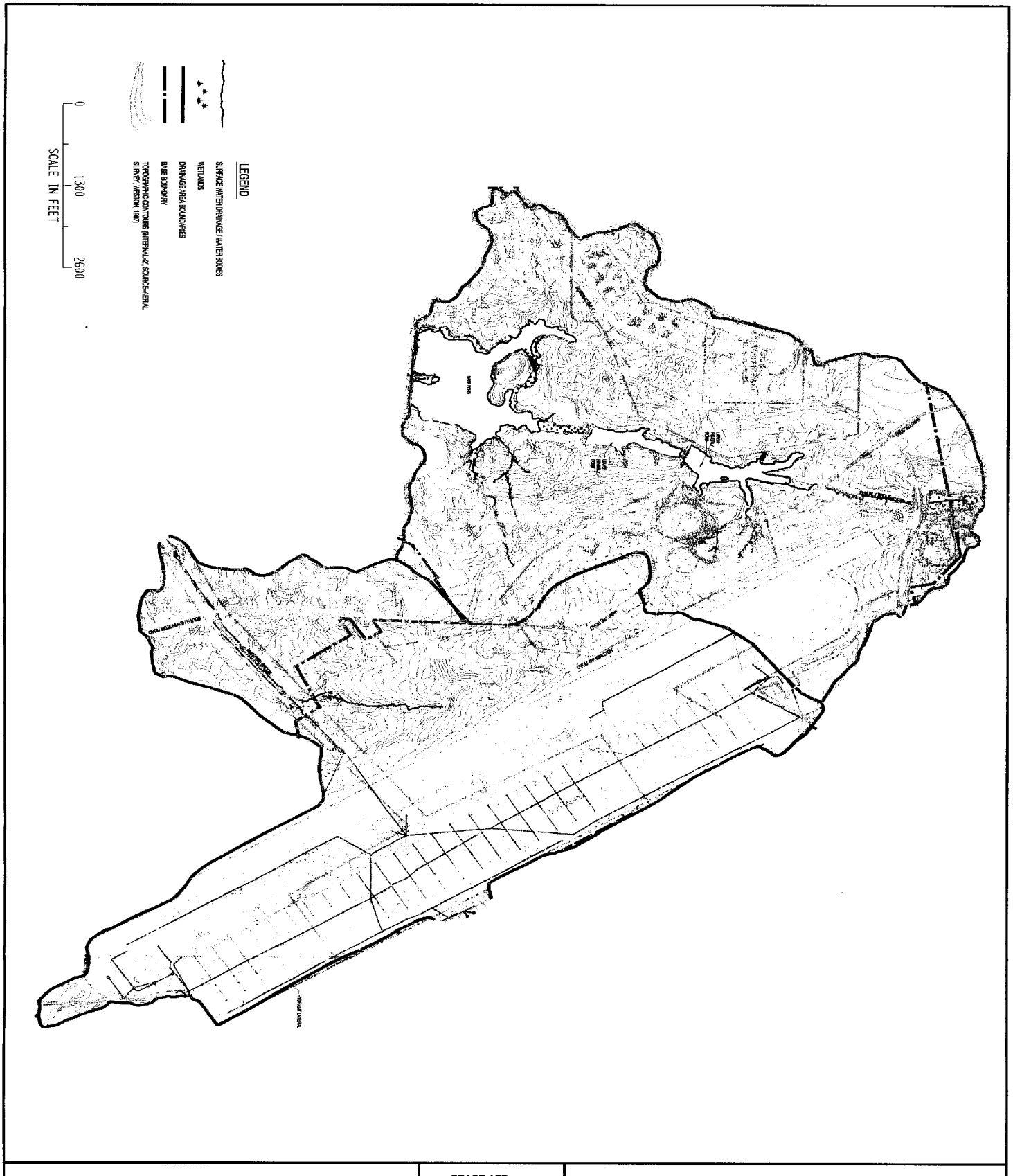


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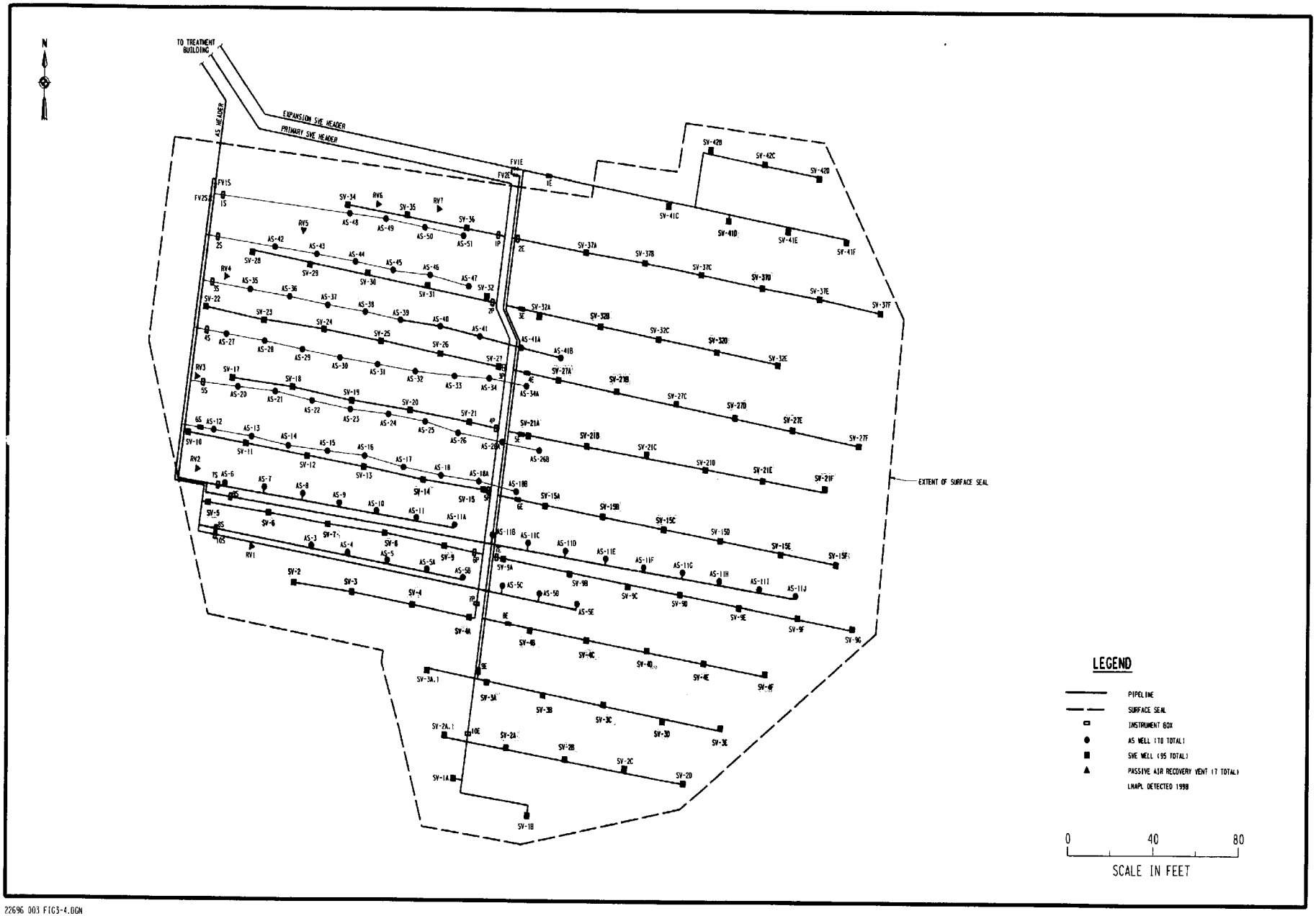
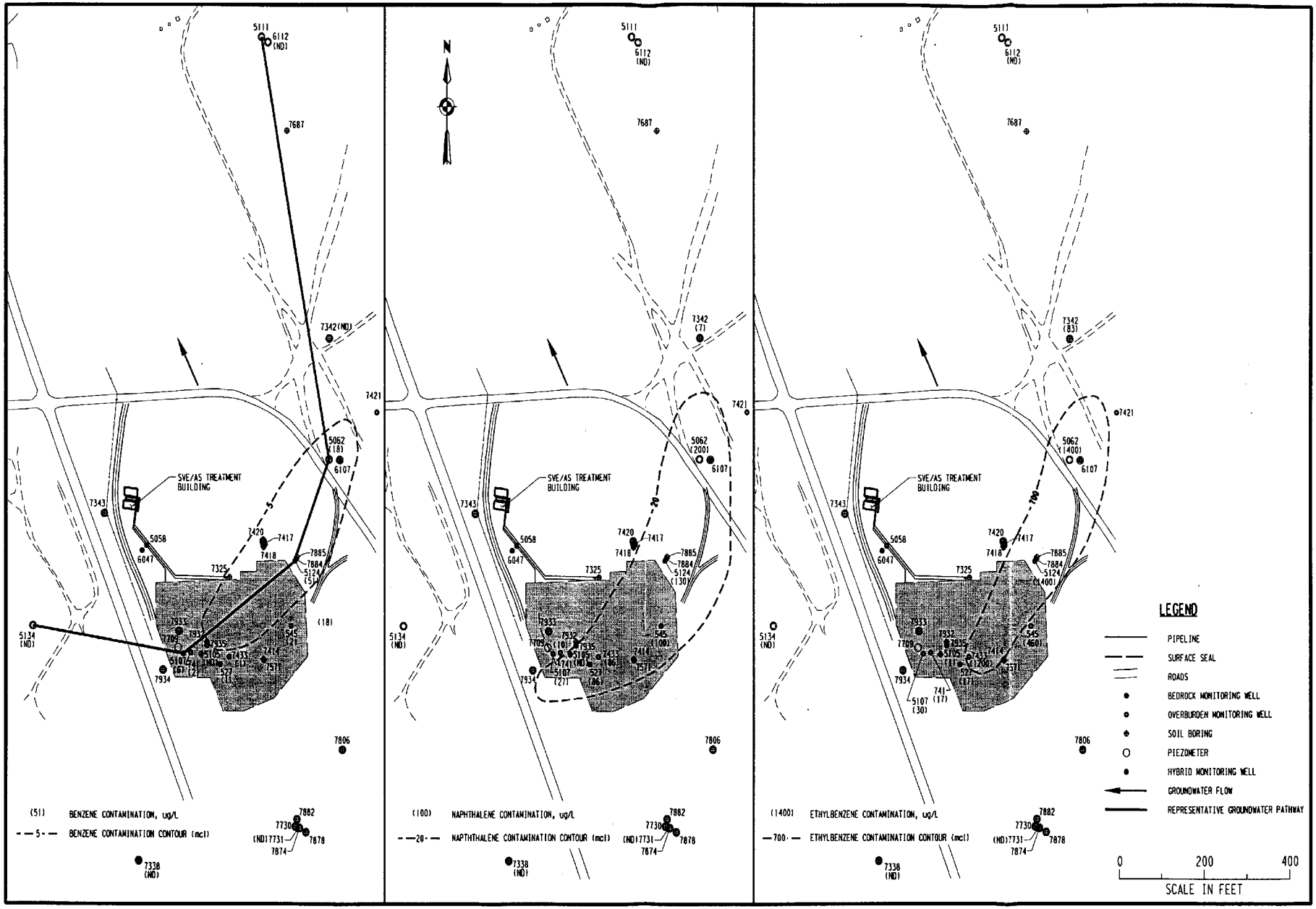
Figure 2.2-4
Surface Water Pathways
Zone 2
Pease Air Force Base, New Hampshire

11 X 17



22696 003 FIG3-4.DGN

Figure 2.2-5
SVE / AS Well Layout and Extent of LNAPL
Site 22; Burn Area-1
Pease AFB, NH



22696 003 F06.DGN

Figure 2.2-6
Site 22 Contaminant Contours - Spring 1998
Zone 2
Pease AFB, NH

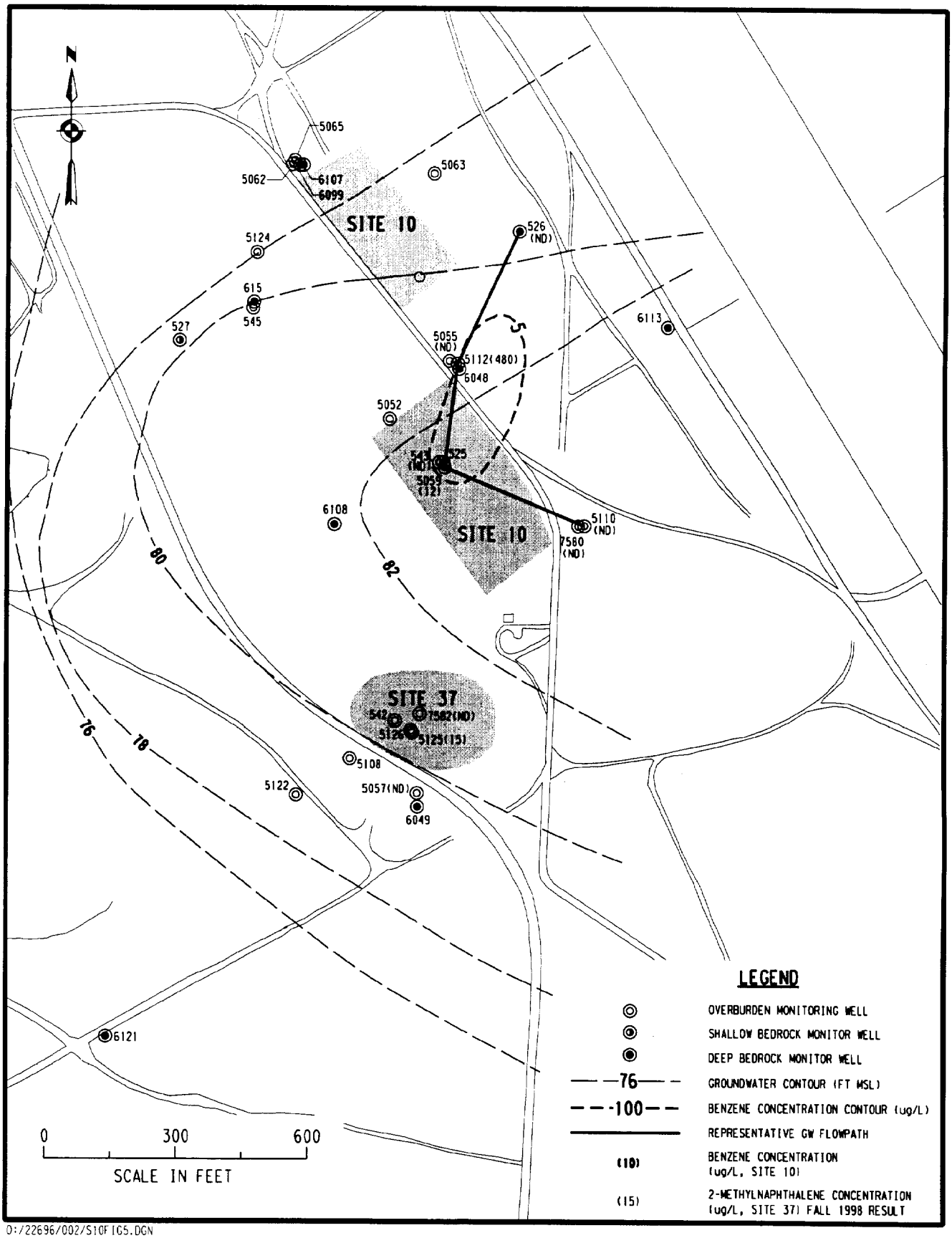


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Figure 2.2-7
Site 10 and 37 Contaminant Contours - Spring 1998
Zone 2
Pease AFB, NH

	1997	1998	Total
Source Area	3990	4630	8620
Expansion Area	5930	9920	15850
Total	9920	14550	24470

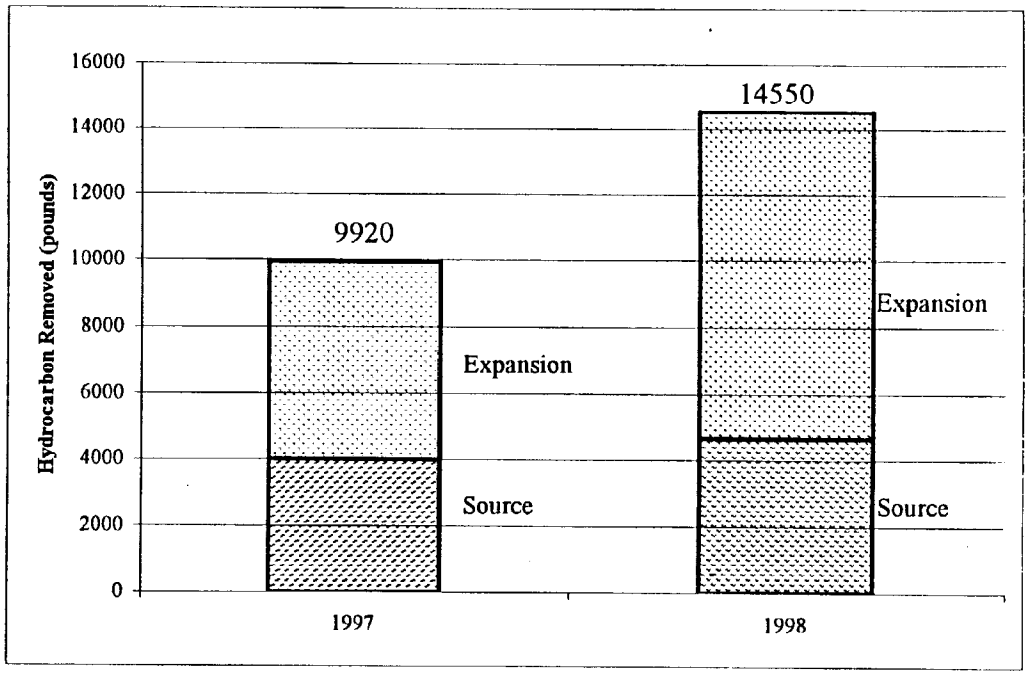

Figure 2.2-8
Pounds of Hydrocarbon Removed
Site 22; Burn Area 1
Pease AFB, NH